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WIFI 6 GHZ RF EXPOSURE EVALUATION

Applicant Name

Samsung Electronics Co., Ltd.
129, Samsung-ro, Maetan dong,
Yeongtong-gu, Suwon-si
Gyeonggi-do, 16677, Korea

Date of Testing

11/08/2021 – 12/08/2021

Test Site/Location

PCTEST, Columbia, MD, USA

Document Serial No:

1M2109220110-25.A3L

FCC ID:**A3LSMS908E****APPLICANT:****SAMSUNG ELECTRONICS CO., LTD.****DUT Type:**

Portable Handset

Application Type:

Certification

FCC Rule Part(s):

CFR §2.1093

Model:

SM-S908E/DS

Additional Model:

SM-S908E

Band & Mode	Tx Frequency	SAR			APD			PD
	MHz	1g Head (W/kg)	1g Body-worn (W/kg)	10g Phablet (W/kg)	Head (W/m ²)	Body-worn (W/m ²)	Phablet (W/m ²)	psPD (W/m ²)
WIFI 6 GHz	5935-7115	0.201	<0.1	0.344	1.150	0.091	5.550	4.258

Values above represent RF exposure evaluations during MIMO operations.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them. Test results reported herein relate only to the item(s) tested.

Randy Ortanez
President



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FCC ID: A3LSMS908E		WIFI 6 GHZ RF EXPOSURE EVALUATION		Approved by: Technical Manager
Document S/N: 1M2109220110-25.A3L	Test Dates: 11/08/2021 – 12/08/2021	DUT Type: Portable Handset		Page 1 of 27

TABLE OF CONTENTS

1	DEVICE UNDER TEST	3
1.1	Device Overview	3
1.2	Nominal and Maximum Output Power Specifications	4
1.2.1	Maximum MIMO WLAN Output Power	4
1.3	DUT Antenna Locations	5
1.4	Miscellaneous Testing Considerations	6
1.5	Guidance Applied	6
2	RF EXPOSURE LIMITS	7
2.1	Uncontrolled Environment	7
2.2	Controlled Environment	7
2.3	RF Exposure Limits for Frequencies Below 6 GHz	7
2.4	RF Exposure Limits for Frequencies Above 6 GHz	8
3	RF CONDUCTED POWERS	9
4	SYSTEM VERIFICATION	12
4.1	SAR Test System Verification	12
4.2	Power Density Test System Verification	14
5	DATA SUMMARY	16
5.1	SAR and Absorbed Power Density Results	16
5.2	Power Density Results	19
6	EQUIPMENT LIST	21
7	MEASUREMENT UNCERTAINTIES	22
9	CONCLUSION	24
9.1	Measurement Conclusion	24
10	REFERENCES	25

APPENDIX A: TEST PLOTS



APPENDIX B: SYSTEM VERIFICATION PLOTS

APPENDIX C: DUT ANTENNA DIAGRAM AND TEST SETUP PHOTOGRAPHS

APPENDIX D: PROBE AND VERIFICATION SOURCE CALIBRATION CERTIFICATES

APPENDIX E: SAR TISSUE SPECIFICATIONS




APPENDIX F: SAR SYSTEM VALIDATION

FCC ID: A3LSMS908E		WIFI 6 GHZ RF EXPOSURE EVALUATION		Approved by: Technical Manager
Document S/N: 1M2109220110-25.A3L	Test Dates: 11/08/2021 – 12/08/2021	DUT Type: Portable Handset	Page 2 of 27	

1 DEVICE UNDER TEST

1.1 Device Overview

Band & Mode	Tx Frequency
U-NII-5	5925 - 6425 MHz
U-NII-6	6425 - 6525 MHz
U-NII-7	6525 - 6875 MHz
U-NII-8	6875 - 7125 MHz




FCC ID: A3LSMS908E	 PCTEST Proud to be part of 	WIFI 6 GHZ RF EXPOSURE EVALUATION		Approved by: Technical Manager
Document S/N: 1M2109220110-25.A3L	Test Dates: 11/08/2021 – 12/08/2021	DUT Type: Portable Handset		Page 3 of 27

1.2 Nominal and Maximum Output Power Specifications

The device operates using the following maximum and nominal output power specifications. SAR values were scaled to the maximum allowed power to determine compliance per KDB publication 447498 D01v06.

1.2.1 Maximum MIMO WLAN Output Power

Mode	Band	IEEE 802.11 (in dBm)			
		MIMO			
		a (CDD + STBC)		ax (SU) (CDD + STBC, SDM)	
		Nominal	Maximum	Nominal	Maximum
6 GHz WIFI (20MHz BW)	U-NII-5	12.0	13.0	12.0	13.0
	U-NII-6	14.0	15.0	14.0	15.0
	U-NII-7	14.0	15.0	14.0	15.0
	U-NII-8	14.0	15.0	14.0	15.0
6 GHz WIFI (40MHz BW)	U-NII-5			15.0	16.0
	U-NII-6				
	U-NII-7				
	U-NII-8				
6 GHz WIFI (80MHz BW)	U-NII-5			15.0	16.0
	U-NII-6				
	U-NII-7				
	U-NII-8				
6 GHz WIFI (160MHz BW)	U-NII-5			15.0	16.0
	U-NII-6				
	U-NII-7				
	U-NII-8				

FCC ID: A3LSMS908E	 PCTEST Proud to be part of 	WIFI 6 GHZ RF EXPOSURE EVALUATION		Approved by: Technical Manager
Document S/N: 1M2109220110-25.A3L	Test Dates: 11/08/2021 – 12/08/2021	DUT Type: Portable Handset	Page 4 of 27	




1.3 DUT Antenna Locations

The overall dimensions of this device are > 9 x 5 cm. A diagram showing the location of the device antennas can be found in SAR Part 1 Report Appendix F. Since the diagonal dimension of this device is > 160 mm and <200 mm, it is considered a “phablet.” Exact antenna dimensions and separation distances are shown in the Technical Descriptions in the FCC filing

**Table 1-1
Device Surfaces**

Device Sides/Edges for Testing						
Mode	Back	Front	Top	Bottom	Right	Left
6 GHz WLAN MIMO	Yes	Yes	Yes	No	No	Yes

Note: Particular DUT edges were not required to be evaluated for phablet SAR if the edges were greater than 2.5 cm from the transmitting antenna according to FCC KDB Publication 941225 D06v02r01 Section III and FCC KDB Publication 648474 D04v01r03. The distances between the transmit antennas and the edges of the device are included in the filing. Wireless router mode is disabled for all 6 GHz WLAN operations.

FCC ID: A3LSMS908E	 PCTEST Proud to be part of 	WIFI 6 GHZ RF EXPOSURE EVALUATION		Approved by: Technical Manager
Document S/N: 1M2109220110-25.A3L	Test Dates: 11/08/2021 – 12/08/2021	DUT Type: Portable Handset	Page 5 of 27	

1.4 Miscellaneous Testing Considerations




Per FCC guidance, SAR was performed using 6.5 GHz SAR probe calibration factors. FCC KDB 648474 and FCC KDB 248227 were followed for test positions, distances, and modes. Per TCB workshop October 2020 notes, 5 channels were tested. Absorbed power density (APD) using a 4cm² averaging area is reported based on SAR measurements. Incident power density is evaluated at 2mm ensuring that the resolution is sufficient such that integrated power density (iPD) between d=2mm and d= λ /5mm is \geq -1dB per equipment manufacturer guidance. Power density results are scaled up for uncertainty above 30%.

Per FCC KDB Publication 648474 D04v01r03, this device is considered a "phablet" since the diagonal dimension is greater than 160mm and less than 200mm. Therefore, phablet SAR tests are required when wireless router mode does not apply or if wireless router 1g SAR > 1.2 W/kg.

6 GHz WIFI SAR results are used for simultaneous transmission analysis with the other transmitters. Analysis can be found in SAR report.

1.5 Guidance Applied

- November 2017, October 2018, April 2019, November 2019, October 2020 TCBC Workshop Notes
- SPEAG DASY6 System Handbook
- SPEAG DASY6 Application Note (Interim Procedures for Devices Operating at 6-10 GHz) (Nov 2021)
- IEEE 1528-2013
- IEC TR 63170:2018
- IEC 62479:2010
- FCC KDB 865664 D02 v01r02
- FCC KDB 648474 D04 v01r03
- FCC KDB 248227 D01 v02r02
- FCC KDB 447498 D01 v06
- FCC KDB 865664 D01 v01r04

FCC ID: A3LSMS908E	 PCTEST Proud to be part of 	WIFI 6 GHZ RF EXPOSURE EVALUATION		Approved by: Technical Manager
Document S/N: 1M2109220110-25.A3L	Test Dates: 11/08/2021 – 12/08/2021	DUT Type: Portable Handset		Page 6 of 27

2.1 Uncontrolled Environment

UNCONTROLLED ENVIRONMENTS are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

2.2 Controlled Environment



CONTROLLED ENVIRONMENTS are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

2.3 RF Exposure Limits for Frequencies Below 6 GHz

Table 2-1
SAR Human Exposure Specified in ANSI/IEEE C95.1-1992 and Health Canada Safety Code 6

HUMAN EXPOSURE LIMITS		
	UNCONTROLLED ENVIRONMENT <i>General Population</i> (W/kg) or (mW/g)	CONTROLLED ENVIRONMENT <i>Occupational</i> (W/kg) or (mW/g)
Peak Spatial Average SAR Head	1.6	8.0
Whole Body SAR	0.08	0.4
Peak Spatial Average SAR Hands, Feet, Ankle, Wrists, etc.	4.0	20

1. The Spatial Peak value of the SAR averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.
2. The Spatial Average value of the SAR averaged over the whole body.
3. The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

FCC ID: A3LSMS908E	 PCTEST Proud to be part of  SAMSUNG	WIFI 6 GHZ RF EXPOSURE EVALUATION	Approved by: Technical Manager
Document S/N: 1M2109220110-25.A3L	Test Dates: 11/08/2021 – 12/08/2021	DUT Type: Portable Handset	Page 7 of 27

2.4 RF Exposure Limits for Frequencies Above 6 GHz

Per §1.1310 (d)(3), the MPE limits are applied for frequencies above 6 GHz. Power Density is expressed in units of W/m² or mW/cm².

Peak Spatially Averaged Power Density was evaluated over a circular area of 4 cm² per interim FCC Guidance for near-field power density evaluations per October 2018 TCB Workshop notes.

**Table 2-2
Human Exposure Limits Specified in FCC 47 CFR §1.1310**

Human Exposure to Radiofrequency (RF) Radiation Limits		
Frequency Range [MHz]	Power Density [mW/cm ²]	Average Time [Minutes]
(A) Limits For Occupational / Controlled Environments		
1,500 – 100,000	5.0	6
(B) Limits For General Population / Uncontrolled Environments		
1,500 – 100,000	1.0	30

Note: 1.0 mW/cm² is 10 W/m²




FCC ID: A3LSMS908E	 PCTEST Proud to be part of 	WIFI 6 GHZ RF EXPOSURE EVALUATION		Approved by: Technical Manager
Document S/N: 1M2109220110-25.A3L	Test Dates: 11/08/2021 – 12/08/2021	DUT Type: Portable Handset	Page 8 of 27	

Table 3-1
6 GHz WLAN Maximum Average RF Power – 802.11a 20 MHz BW

6GHz (20MHz) 802.11a Conducted Power [dBm]				
Freq [MHz]	Channel	ANT1	ANT2	MIMO
5935	2	9.35	9.43	12.40
6075	25	9.34	9.22	12.29
6175	45	9.20	9.01	12.12
6275	65	9.36	9.30	12.34
6415	93	9.49	9.40	12.46
6535	117	11.72	11.33	14.54
6875	185	11.26	11.80	14.55
7115	233	11.20	11.26	14.24

Table 3-2
6 GHz WLAN Maximum Average RF Power – 802.11ax 20 MHz BW

6GHz (20MHz) 802.11ax Conducted Power [dBm]				
Freq [MHz]	Channel	ANT1	ANT2	MIMO
5935	2	9.64	9.83	12.75
6075	25	9.29	9.36	12.34
6175	45	9.41	9.22	12.33
6275	65	9.72	9.50	12.62
6415	93	9.41	9.42	12.43
6875	185	11.50	11.81	14.67
7115	233	11.24	11.35	14.31






FCC ID: A3LSMS908E	 PCTEST Proud to be part of 	WIFI 6 GHZ RF EXPOSURE EVALUATION		Approved by: Technical Manager
Document S/N: 1M2109220110-25.A3L	Test Dates: 11/08/2021 – 12/08/2021	DUT Type: Portable Handset	Page 9 of 27	

Table 3-3
6 GHz WLAN Maximum Average RF Power – 802.11ax 40 MHz BW

6GHz (40MHz) 802.11ax Conducted Power [dBm]				
Freq [MHz]	Channel	ANT1	ANT2	MIMO
5965	3	12.41	12.56	15.50
6085	27	12.30	12.33	15.33
6165	43	12.40	12.28	15.35
6285	67	12.62	12.57	15.61
6405	91	12.56	12.62	15.60
6845	179	12.47	12.42	15.46
6885	187	12.62	12.32	15.48
7005	211	12.01	12.92	15.50
7085	227	12.28	12.32	15.31

Table 3-4
6 GHz WLAN Maximum Average RF Power – 802.11ax 80 MHz BW

6GHz (80MHz) 802.11ax Conducted Power [dBm]				
Freq [MHz]	Channel	ANT1	ANT2	MIMO
6065	23	12.42	11.79	15.13
6305	71	12.99	12.70	15.86
6385	87	12.94	12.76	15.86
6465	103	12.63	12.02	15.34
6545	119	12.57	11.84	15.23
6705	151	12.71	11.89	15.33
6785	167	12.50	12.97	15.75
6865	183	12.65	12.60	15.63
7025	215	11.51	12.51	15.05

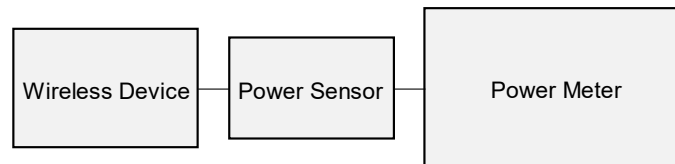
FCC ID: A3LSMS908E		WIFI 6 GHZ RF EXPOSURE EVALUATION		Approved by: Technical Manager
Document S/N: 1M2109220110-25.A3L	Test Dates: 11/08/2021 – 12/08/2021	DUT Type: Portable Handset		Page 10 of 27

**Table 3-5
6 GHz WLAN Maximum Average RF Power – 802.11ax 160 MHz BW**



6GHz (160MHz) 802.11ax Conducted Power [dBm]				
Freq [MHz]	Channel	ANT1	ANT2	MIMO
6025	15	12.29	12.58	15.45
6185	47	12.37	12.28	15.33
6345	79	12.17	12.61	15.41
6505	111	12.74	12.16	15.47
6665	143	12.75	12.09	15.45
6825	175	12.14	12.65	15.41
6985	207	11.59	12.66	15.17

Justification for test configurations for WLAN per KDB Publication 248227 D01v02r02:

- Power measurements were performed for the transmission mode configuration with the highest maximum output power specified for production units.
- For transmission modes with the same maximum output power specification, powers were measured for the largest channel bandwidth, lowest order modulation and lowest data rate.
- For transmission modes with identical maximum specified output power, channel bandwidth, modulation and data rates, power measurements were required for all identical configurations.
- For each transmission mode configuration, powers were measured for the highest and lowest channels; and at the mid-band channel(s) when there were at least 3 channels supported. For configurations with multiple mid-band channels, due to an even number of channels, both channels were measured.



**Figure 3-1
Power Measurement Setup**

FCC ID: A3LSMS908E		WIFI 6 GHZ RF EXPOSURE EVALUATION		Approved by: Technical Manager
Document S/N: 1M2109220110-25.A3L	Test Dates: 11/08/2021 – 12/08/2021	DUT Type: Portable Handset	Page 11 of 27	

4

SYSTEM VERIFICATION



4.1 SAR Test System Verification

**Table 4-1
Measured Tissue Properties**

Calibrated for Tests Performed on:	Tissue Type	Tissue Temp During Calibration (°C)	Measured Frequency (MHz)	Measured Conductivity, σ (S/m)	Measured Dielectric Constant, ϵ	TARGET Conductivity, σ (S/m)	TARGET Dielectric Constant, ϵ	% dev σ	% dev ϵ
12/06/2021	6500 Head	20.2	6000	5.5456	33.7941	5.480	35.100	1.20%	-3.72%
			6025	5.5478	33.6993	5.510	35.070	0.69%	-3.91%
			6065	5.6247	33.5458	5.557	35.022	1.22%	-4.22%
			6075	5.6474	33.5197	5.569	35.010	1.41%	-4.26%
			6085	5.6737	33.5066	5.580	34.998	1.68%	-4.26%
			6275	5.8837	33.2797	5.805	34.770	1.36%	-4.29%
			6285	5.8928	33.2703	5.816	34.758	1.32%	-4.28%
			6305	5.9067	33.1805	5.840	34.734	1.14%	-4.47%
			6345	5.9452	33.0046	5.887	34.686	0.99%	-4.85%
			6475	6.1201	32.7795	6.041	34.530	1.31%	-5.07%
			6485	6.1204	32.7765	6.052	34.518	1.13%	-5.05%
			6500	6.1224	32.7706	6.070	34.500	0.86%	-5.01%
			6505	6.1298	32.7659	6.076	34.494	0.89%	-5.01%
			6545	6.1851	32.6323	6.122	34.446	1.03%	-5.27%
			6675	6.3694	32.4914	6.273	34.290	1.54%	-5.25%
			6685	6.3716	32.4533	6.285	34.278	1.38%	-5.32%
			6785	6.4848	32.422	6.400	34.158	1.32%	-5.08%
			6825	6.4852	32.1207	6.447	34.110	0.59%	-5.83%
			6985	6.6635	31.8877	6.633	33.918	0.46%	-5.99%
			12/08/2021	6500 Head	19.5	6000	5.567	33.567	5.48
6065	5.667	33.484				5.557	35.022	1.98%	-4.39%
6075	5.686	33.432				5.569	35.01	2.10%	-4.51%
6275	5.916	33.06				5.805	34.77	1.91%	-4.92%
6305	5.941	33.05				5.84	34.734	1.73%	-4.85%
6475	6.162	32.726				6.041	34.53	2.00%	-5.22%
6500	6.166	32.708				6.07	34.5	1.58%	-5.19%
6545	6.221	32.538				6.122	34.446	1.62%	-5.54%
6675	6.41	32.38				6.27	34.29	2.14%	-5.58%
6785	6.53	32.27				6.40	34.16	2.09%	-5.54%
6995	6.75	31.75				6.64	33.91	1.64%	-6.37%
7025	6.76	31.62				6.68	33.87	1.18%	-6.63%

The above measured tissue parameters were used in the DASY software. The DASY software was used to perform interpolation to determine the dielectric parameters at the SAR test device frequencies (per KDB Publication 865664 D01v01r04 and IEEE 1528-2013 6.6.1.2). The tissue parameters listed in the SAR test plots may slightly differ from the table above due to significant digit rounding in the software.

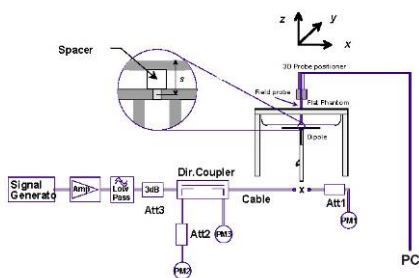
The SAR measurement systems have implemented the SAR error compensation algorithms documented in IEC 62209-2 to automatically compensate the measured SAR results for deviations between the measured and required tissue dielectric parameters for all frequencies. The test lab has verified that the required SAR error compensation algorithm has been correctly applied to only scale up the measured SAR, not downward.

FCC ID: A3LSMS908E	 PCTEST Proud to be part of Samsung	WIFI 6 GHZ RF EXPOSURE EVALUATION		Approved by: Technical Manager
Document S/N: 1M2109220110-25.A3L	Test Dates: 11/08/2021 – 12/08/2021	DUT Type: Portable Handset	Page 12 of 27	

Prior to SAR assessment, the system is verified to $\pm 10\%$ of the SAR measurement on the reference dipole at the time of calibration by the calibration facility. Full system validation status and result summary can be found in Appendix F.

**Table 4-2
System Verification Results**



System Verification TARGET & MEASURED																				
SAR System #	Tissue Frequency (MHz)	Tissue Type	Date	Amb. Temp (°C)	Liquid Temp (°C)	Input Power (W)	Source SN	Probe SN	Measured SAR _{1g} (W/kg)	1 W Target SAR _{1g} (W/kg)	1 W Normalized SAR _{1g} (W/kg)	Deviation _{1g} (%)	Measured SAR _{10g} (W/kg)	1 W Target SAR _{10g} (W/kg)	1 W Normalized SAR _{10g} (W/kg)	Deviation _{10g} (%)	Measured 4cm ² APD (W/m ²)	1W Target 4cm ² APD (W/m ²)	1 W Normalized 4cm ² APD (W/m ²)	Deviation 4cm ² APD (%)
O	6500	Head	12/06/2021	20.5	20.2	0.050	1019	7659	14.200	293.000	284.000	-3.07%	2.610	53.600	52.200	-2.61%	63.7000	1340.0000	1274.000	-4.93%
O	6500	Head	12/08/2021	20.0	19.5	0.050	1019	7659	14.700	293.000	294.000	0.34%	2.690	53.600	53.800	0.37%	65.7000	1340.0000	1314.000	-1.94%



**Figure 4-1
System Verification Setup Diagram**



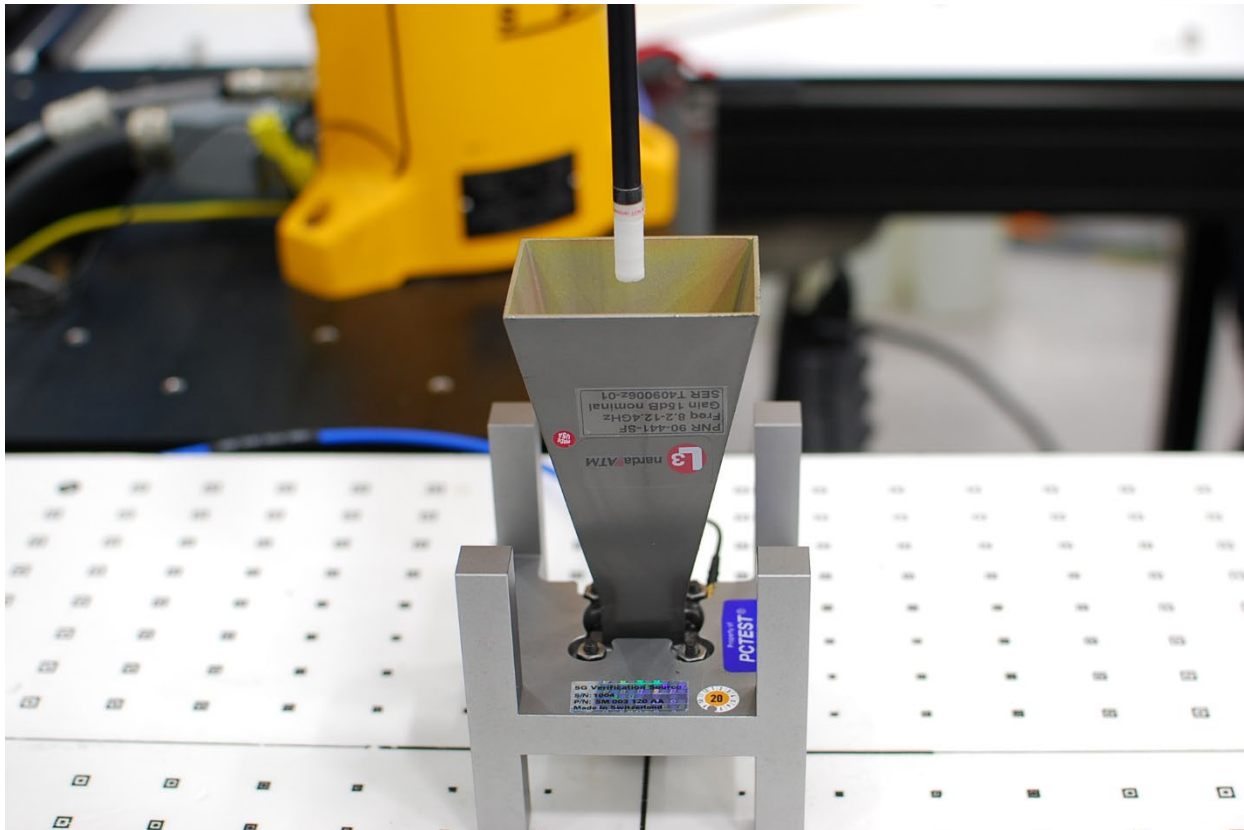
**Figure 4-2
System Verification Setup Photo**

FCC ID: A3LSMS908E		WIFI 6 GHZ RF EXPOSURE EVALUATION		Approved by: Technical Manager
Document S/N: 1M2109220110-25.A3L	Test Dates: 11/08/2021 – 12/08/2021	DUT Type: Portable Handset		Page 13 of 27




4.2 Power Density Test System Verification

The system was verified to be within ± 0.66 dB of the power density targets on the calibration certificate according to the test system specification in the user's manual and calibration facility recommendation. The 0.66 dB deviation threshold represents the expanded uncertainty for system performance checks using SPEAG's mmWave verification sources. The same spatial resolution and measurement region used in the source calibration was applied during the system check.

The measured power density distribution of verification source was also confirmed through visual inspection to have no noticeable differences, both spatially (shape) and numerically (level) from the distribution provided by the manufacturer, per November 2017 TCBC Workshop Notes.





**Figure 4-3
System Verification Setup Photo**

FCC ID: A3LSMS908E	 <small>Proud to be part of</small> 	WIFI 6 GHZ RF EXPOSURE EVALUATION	 Approved by: Technical Manager
Document S/N: 1M2109220110-25.A3L	Test Dates: 11/08/2021 – 12/08/2021	DUT Type: Portable Handset	Page 14 of 27

**Table 4-3
10 GHz Verifications**

System Verification											
System	Frequency (GHz)	Date	Source S/N	Probe S/N	Prad (mW)	Normal psPD (W/m ² over 4 cm ²)		Deviation (dB)	Total psPD (W/m ² over 4 cm ²)		Deviation (dB)
						Measured	Target		Measured	Target	
R	10	11/08/2021	1004	9523	86.1	49.10	50.70	-0.14	49.20	50.70	-0.13

Note: A **10 mm distance spacing** was used from the reference horn antenna aperture to the probe element.

FCC ID: A3LSMS908E		WIFI 6 GHZ RF EXPOSURE EVALUATION		Approved by: Technical Manager
Document S/N: 1M2109220110-25.A3L	Test Dates: 11/08/2021 – 12/08/2021	DUT Type: Portable Handset	Page 15 of 27	

5

DATA SUMMARY

5.1 SAR and Absorbed Power Density Results

**Table 5-1
6 GHz WLAN Head MIMO SAR**

MEASUREMENT RESULTS																				
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power (Ant 1) [dBm]	Conducted Power (Ant 1) [dBm]	Maximum Allowed Power (Ant 2) [dBm]	Conducted Power (Ant 2) [dBm]	Power Drift [dB]	Side	Test Position	Antenna Config.	Device Serial Number	Data Rate (Mbps)	Duty Cycle (%)	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Reported SAR (1g)	Plot #
MHz	Ch.															(W/kg)			(W/kg)	
6065.00	23	802.11ax	OFDM	80	13.0	12.42	13.0	11.79	-0.12	Right	Cheek	MIMO	UJK0850M	68.1	90.6	0.138	1.322	1.104	0.201	A1
6305.00	71	802.11ax	OFDM	80	13.0	12.99	13.0	12.70	0.08	Right	Cheek	MIMO	UJK0850M	68.1	90.6	0.071	1.072	1.104	0.084	
6545.00	119	802.11ax	OFDM	80	13.0	12.57	13.0	11.84	0.00	Right	Cheek	MIMO	UJK0850M	68.1	90.6	0.036	1.306	1.104	0.052	
6785.00	167	802.11ax	OFDM	80	13.0	12.50	13.0	12.97	0.13	Right	Cheek	MIMO	UJK0850M	68.1	90.6	0.054	1.122	1.104	0.067	
7025.00	215	802.11ax	OFDM	80	13.0	11.51	13.0	12.51	0.17	Right	Cheek	MIMO	UJK0850M	68.1	90.6	0.033	1.409	1.104	0.051	
6305.00	71	802.11ax	OFDM	80	13.0	12.99	13.0	12.70	-0.11	Right	Tilt	MIMO	UJK0850M	68.1	90.6	0.004	1.072	1.104	0.005	
6305.00	71	802.11ax	OFDM	80	13.0	12.99	13.0	12.70	-0.16	Left	Cheek	MIMO	UJK0850M	68.1	90.6	0.053	1.072	1.104	0.063	
6305.00	71	802.11ax	OFDM	80	13.0	12.99	13.0	12.70	0.00	Left	Tilt	MIMO	UJK0850M	68.1	90.6	0.023	1.072	1.104	0.027	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population										Head 1.6 W/kg (mW/g) averaged over 1 gram										

Note: To achieve the 16 dBm maximum allowed MIMO power shown in the documentation, each antenna transmits at a maximum allowed power of 13 dBm.

**Table 5-2
6 GHz WLAN Body-worn MIMO SAR**



MEASUREMENT RESULTS																				
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power (Ant 1) [dBm]	Conducted Power (Ant 1) [dBm]	Maximum Allowed Power (Ant 2) [dBm]	Conducted Power (Ant 2) [dBm]	Power Drift [dB]	Spacing (mm)	Antenna Config.	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle (%)	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Reported SAR (1g)	Plot #
MHz	Ch.															(W/kg)			(W/kg)	
6305.00	71	802.11ax	OFDM	80	13.0	12.99	13.0	12.70	-0.12	15	MIMO	UJK0850M	68.1	Back	90.6	0.013	1.072	1.104	0.015	A2
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population										Body 1.6 W/kg (mW/g) averaged over 1 gram										

Note: To achieve the 16 dBm maximum allowed MIMO power shown in the documentation, each antenna transmits at a maximum allowed power of 13 dBm.

**Table 5-3
6 GHz WLAN Phablet MIMO SAR**

MEASUREMENT RESULTS																		
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power (Ant 1) [dBm]	Conducted Power (Ant 1) [dBm]	Maximum Allowed Power (Ant 2) [dBm]	Conducted Power (Ant 2) [dBm]	Power Drift [dB]	Spacing (mm)	Antenna Config.	Device Serial Number	Peak Number	Data Rate (Mbps)	Side	Duty Cycle (%)	Measured APD	Plot #
MHz	Ch.																(W/m ² (4cm ²))	
6305.00	71	802.11ax	OFDM	80	13.0	12.99	13.0	12.70	-0.09	0	MIMO	UJK0850M	1	68.1	Back	90.6	1.870	
6305.00	71	802.11ax	OFDM	80	13.0	12.99	13.0	12.70	-0.02	0	MIMO	UJK0850M	2	68.1	Back	90.6	1.840	
6305.00	71	802.11ax	OFDM	80	13.0	12.99	13.0	12.70	-0.20	0	MIMO	UJK0850M	-	68.1	Front	90.6	2.180	
6305.00	71	802.11ax	OFDM	80	13.0	12.99	13.0	12.70	-0.04	0	MIMO	UJK0850M	-	68.1	Top	90.6	0.227	
6065.00	23	802.11ax	OFDM	80	13.0	12.42	13.0	11.79	0.06	0	MIMO	UJK0850M	-	68.1	Left	90.6	5.550	A3
6305.00	71	802.11ax	OFDM	80	13.0	12.99	13.0	12.70	0.02	0	MIMO	UJK0850M	-	68.1	Left	90.6	4.460	
6545.00	119	802.11ax	OFDM	80	13.0	12.57	13.0	11.84	-0.14	0	MIMO	UJK0850M	-	68.1	Left	90.6	3.650	
6785.00	167	802.11ax	OFDM	80	13.0	12.50	13.0	12.97	0.04	0	MIMO	UJK0850M	-	68.1	Left	90.6	4.250	
7025.00	215	802.11ax	OFDM	80	13.0	11.51	13.0	12.51	0.09	0	MIMO	UJK0850M	-	68.1	Left	90.6	3.020	

Note: To achieve the 16 dBm maximum allowed MIMO power shown in the documentation, each antenna transmits at a maximum allowed power of 13 dBm.

FCC ID: A3LSMS908E		WIFI 6 GHZ RF EXPOSURE EVALUATION		Approved by: Technical Manager
Document S/N: 1M2109220110-25.A3L	Test Dates: 11/08/2021 – 12/08/2021	DUT Type: Portable Handset		Page 16 of 27

**Table 5-4
6 GHz WLAN Head MIMO Absorbed Power Density**

MEASUREMENT RESULTS																	
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power (Ant 1) [dBm]	Conducted Power (Ant 1) [dBm]	Maximum Allowed Power (Ant 2) [dBm]	Conducted Power (Ant 2) [dBm]	Power Drift [dB]	Side	Test Position	Antenna Config.	Device Serial Number	Data Rate (Mbps)	Duty Cycle (%)	Measured APD W/m ² (4cm ²)	Plot #
MHz	Ch.																
6065.00	23	802.11ax	OFDM	80	13.0	12.42	13.0	11.79	-0.12	Right	Cheek	MIMO	UJK0850M	68.1	90.6	1.150	A1
6305.00	71	802.11ax	OFDM	80	13.0	12.99	13.0	12.70	0.08	Right	Cheek	MIMO	UJK0850M	68.1	90.6	0.421	
6545.00	119	802.11ax	OFDM	80	13.0	12.57	13.0	11.84	0.00	Right	Cheek	MIMO	UJK0850M	68.1	90.6	0.219	
6785.00	167	802.11ax	OFDM	80	13.0	12.50	13.0	12.97	0.13	Right	Cheek	MIMO	UJK0850M	68.1	90.6	0.391	
7025.00	215	802.11ax	OFDM	80	13.0	11.51	13.0	12.51	0.17	Right	Cheek	MIMO	UJK0850M	68.1	90.6	0.226	
6305.00	71	802.11ax	OFDM	80	13.0	12.99	13.0	12.70	-0.11	Right	Tilt	MIMO	UJK0850M	68.1	90.6	0.027	
6305.00	71	802.11ax	OFDM	80	13.0	12.99	13.0	12.70	-0.16	Left	Cheek	MIMO	UJK0850M	68.1	90.6	0.342	
6305.00	71	802.11ax	OFDM	80	13.0	12.99	13.0	12.70	0.00	Left	Tilt	MIMO	UJK0850M	68.1	90.6	0.170	

Note: To achieve the 16 dBm maximum allowed MIMO power shown in the documentation, each antenna transmits at a maximum allowed power of 13 dBm.

**Table 5-5
6 GHz WLAN Body-worn MIMO Absorbed Power Density**




MEASUREMENT RESULTS																	
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power (Ant 1) [dBm]	Conducted Power (Ant 1) [dBm]	Maximum Allowed Power (Ant 2) [dBm]	Conducted Power (Ant 2) [dBm]	Power Drift [dB]	Spacing (mm)	Antenna Config.	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle (%)	Measured APD W/m ² (4cm ²)	Plot #
MHz	Ch.																
6305.00	71	802.11ax	OFDM	80	13.0	12.99	13.0	12.70	-0.12	15.0	MIMO	UJK0850M	68.1	Back	90.6	0.091	A2

Note: To achieve the 16 dBm maximum allowed MIMO power shown in the documentation, each antenna transmits at a maximum allowed power of 13 dBm.

**Table 5-6
6 GHz WLAN Phablet MIMO Absorbed Power Density**

MEASUREMENT RESULTS																					
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power (Ant 1) [dBm]	Conducted Power (Ant 1) [dBm]	Maximum Allowed Power (Ant 2) [dBm]	Conducted Power (Ant 2) [dBm]	Power Drift [dB]	Spacing (mm)	Antenna Config.	Device Serial Number	Peak Number	Data Rate (Mbps)	Side	Duty Cycle (%)	SAR (10g) (W/kg)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Reported SAR (10g) (W/kg)	Plot #
MHz	Ch.																				
6305.00	71	802.11ax	OFDM	80	13.0	12.99	13.0	12.70	-0.09	0	MIMO	UJK0850M	1	68.1	Back	90.6	0.082	1.072	1.104	0.097	
6305.00	71	802.11ax	OFDM	80	13.0	12.99	13.0	12.70	-0.02	0	MIMO	UJK0850M	2	68.1	Back	90.6	0.080	1.072	1.104	0.095	
6305.00	71	802.11ax	OFDM	80	13.0	12.99	13.0	12.70	-0.20	0	MIMO	UJK0850M	-	68.1	Front	90.6	0.093	1.072	1.104	0.110	
6305.00	71	802.11ax	OFDM	80	13.0	12.99	13.0	12.70	-0.04	0	MIMO	UJK0850M	-	68.1	Top	90.6	0.010	1.072	1.104	0.012	
6065.00	23	802.11ax	OFDM	80	13.0	12.42	13.0	11.79	0.06	0	MIMO	UJK0850M	-	68.1	Left	90.6	0.236	1.322	1.104	0.344	A3
6305.00	71	802.11ax	OFDM	80	13.0	12.99	13.0	12.70	0.02	0	MIMO	UJK0850M	-	68.1	Left	90.6	0.189	1.072	1.104	0.224	
6545.00	119	802.11ax	OFDM	80	13.0	12.57	13.0	11.84	-0.14	0	MIMO	UJK0850M	-	68.1	Left	90.6	0.157	1.306	1.104	0.226	
6785.00	167	802.11ax	OFDM	80	13.0	12.50	13.0	12.97	0.04	0	MIMO	UJK0850M	-	68.1	Left	90.6	0.184	1.122	1.104	0.228	
7025.00	215	802.11ax	OFDM	80	13.0	11.51	13.0	12.51	0.09	0	MIMO	UJK0850M	-	68.1	Left	90.6	0.131	1.409	1.104	0.204	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT												Phablet									
Spatial Peak												4 W/kg (mW/g)									
Uncontrolled Exposure/General Population												averaged over 10 gram									

Note: To achieve the 16 dBm maximum allowed MIMO power shown in the documentation, each antenna transmits at a maximum allowed power of 13 dBm.



FCC ID: A3LSMS908E	 Proud to be part of 	WIFI 6 GHZ RF EXPOSURE EVALUATION		Approved by: Technical Manager
Document S/N: 1M2109220110-25.A3L	Test Dates: 11/08/2021 – 12/08/2021	DUT Type: Portable Handset	Page 17 of 27	

SAR and Absorbed Power Density General Notes:

1. The test data reported are the worst-case SAR values according to test procedures specified in IEEE 1528-2013, and FCC KDB Publication 447498 D01v06.
2. Batteries are fully charged at the beginning of the SAR measurements.
3. Liquid tissue depth was at least 15.0 cm for all frequencies.
4. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical, and thermal characteristics and are within operational tolerances expected for production units.
5. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v06.
6. Device was tested using a fixed spacing for body-worn accessory testing. A separation distance of 15 mm was considered because the manufacturer has determined that there will be body-worn accessories available in the marketplace for users to support this separation distance.
7. Per FCC KDB Publication 648474 D04v01r03, body-worn SAR was evaluated without a headset connected to the device. Since the standalone reported body-worn SAR was ≤ 1.2 W/kg, no additional body-worn SAR evaluations using a headset cable were required.
8. Per FCC KDB Publication 648474 D04v01r03, this device is considered a "phablet" since the diagonal dimension is > 160 mm and < 200 mm. Therefore, phablet SAR tests are required when wireless router mode does not apply or if wireless router 1g SAR > 1.2 W/kg.
9. Unless otherwise noted, when 10g SAR measurement is considered, a factor of 2.5 is applied to the thresholds below.
10. Per FCC guidance, SAR was performed using 6.5 GHz SAR probe calibration factors. Per October 2020 TCB Workshop notes, 5 channels were tested. Absorbed power density (APD) using a 4cm² averaging area is reported based on SAR measurements.

WLAN Notes:




1. WIFI 6 GHz operations are limited to MIMO operations only (does not support stand-alone mode). Per KDB Publication 248227 D01v02r02, SAR for MIMO was evaluated by following the simultaneous SAR provisions from KDB Publication 447498 D01v06 by making a SAR measurement with both antennas transmitting simultaneously.
2. When the maximum reported 1g averaged SAR is ≤ 0.8 W/kg, SAR testing on additional channels was not required. Otherwise, SAR for the next highest output power channel was required until the reported SAR result was ≤ 1.20 W/kg for 1g evaluations or all test channels were measured.
3. The device was configured to transmit continuously at the required data rate, channel bandwidth and signal modulation, using the highest transmission duty factor supported by the test mode tools. The reported SAR was scaled to the 100% transmission duty factor to determine compliance. Procedures used to measure the duty factor are identical to that in the associated EMC test reports.
4. When 10g SAR measurement is considered, a factor of 2.5 is applied to the thresholds above.
5. When multiple SAR peaks were observed due to separation of the Ant 1 and Ant 2 while operating in MIMO mode, separate zoom scans were evaluated over each antenna location. Peak 1 represents the zoom scan centered over WIFI Antenna 1, while Peak 2 represents the zoom scan centered over WIFI Antenna 2.

FCC ID: A3LSMS908E		WIFI 6 GHZ RF EXPOSURE EVALUATION		Approved by: Technical Manager
Document S/N: 1M2109220110-25.A3L	Test Dates: 11/08/2021 – 12/08/2021	DUT Type: Portable Handset	Page 18 of 27	

5.2 Power Density Results




**Table 5-7
6 GHz WLAN MIMO Power Density**

MEASUREMENT RESULTS																			
Frequency (MHz)	Channel	Mode	Service	Bandwidth [MHz]	Power Drift (dB)	Spacing (mm)	Antenna Config.	DUT Serial Number	Data Rate (Mbps)	Side	Duty Cycle (%)	Grid Step (λ)	IPD (W/m ²)	Scaling Factor for Measurement Uncertainty per IEC 62479	Normal psPD (W/m ²)	Scaled Normal psPD (W/m ²)	Total psPD (W/m ²)	Scaled Total psPD (W/m ²)	Plot #
6305.00	71	802.11ax	OFDM	80	-0.15	2	MIMO	LUK0850M	68.1	Back	90.6	0.0625	0.920	1.554	0.922	1.433	1.210	1.880	
6305.00	71	802.11ax	OFDM	80	-0.02	9.51	MIMO	LUK0850M	68.1	Back	90.6	0.0625	0.751	1.554	0.441	0.685	0.534	0.830	
6305.00	71	802.11ax	OFDM	80	0.20	2	MIMO	LUK0850M	68.1	Front	90.6	0.0625	N/A	1.554	0.471	0.732	0.626	0.973	
6305.00	71	802.11ax	OFDM	80	-0.10	2	MIMO	LUK0850M	68.1	Top	90.6	0.0625	N/A	1.554	0.339	0.527	0.383	0.595	
6065.00	23	802.11ax	OFDM	80	0.19	2	MIMO	LUK0850M	68.1	Left	90.6	0.0625	N/A	1.554	2.330	3.621	2.740	4.258	A4
6305.00	71	802.11ax	OFDM	80	0.01	2	MIMO	LUK0850M	68.1	Left	90.6	0.0625	N/A	1.554	1.270	1.974	1.410	2.191	
6545.00	119	802.11ax	OFDM	80	0.04	2	MIMO	LUK0850M	68.1	Left	90.6	0.0625	N/A	1.554	1.010	1.570	1.120	1.740	
6785.00	167	802.11ax	OFDM	80	0.10	2	MIMO	LUK0850M	68.1	Left	90.6	0.0625	N/A	1.554	1.830	2.844	2.260	3.512	
7025.00	215	802.11ax	OFDM	80	0.10	2	MIMO	LUK0850M	68.1	Left	90.6	0.0625	N/A	1.554	1.280	1.989	1.460	2.289	
47 CFR §1.1310 - SAFETY LIMIT Spatial Average Uncontrolled Exposure / General Population								Power Density 10 W/m ² averaged over 4 cm ²											

FCC ID: A3LSMS908E	 PCTEST Proud to be part of 	WIFI 6 GHZ RF EXPOSURE EVALUATION		Approved by: Technical Manager
Document S/N: 1M2109220110-25.A3L	Test Dates: 11/08/2021 – 12/08/2021	DUT Type: Portable Handset	Page 19 of 27	

Power Density General Notes

1. The manufacturer has confirmed that the devices tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.
2. Batteries are fully charged at the beginning of the measurements. The DUT was connected to a wall charger for some measurements due to the test duration. It was confirmed that the charger plugged into this DUT did not impact the near-field PD test results.
3. Power density was calculated by repeated E-field measurements on two measurement planes separated by $\lambda/4$.
4. The device was configured to transmit continuously at the required data rate, channel bandwidth and signal modulation, using the highest transmission duty factor supported by the test mode tools.
5. Per FCC guidance and equipment manufacturer guidance, power density results were scaled according to IEC 62479:2010 for the portion of the measurement uncertainty > 30%. Total expanded uncertainty of 2.68 dB (85.4%) was used to determine the psPD measurement scaling factor.
6. Per equipment manufacturer guidance, power density was measured at $d=2\text{mm}$ and $d=\lambda/5\text{mm}$ using the same grid size and grid step size for some frequencies and surfaces. The integrated Power Density (iPD) was calculated based on these measurements. Since iPD ratio between the two distances is $\geq -1\text{dB}$, the grid step was sufficient for determining compliance at $d=2\text{mm}$.
7. WIFI 6 GHz operations are limited to MIMO operations only (does not support stand-alone mode). psPD for MIMO was evaluated by making a measurement with both antennas transmitting simultaneously.

FCC ID: A3LSMS908E	 PCTEST <small>Proud to be part of</small> 	WIFI 6 GHZ RF EXPOSURE EVALUATION		Approved by: Technical Manager
Document S/N: 1M2109220110-25.A3L	Test Dates: 11/08/2021 – 12/08/2021	DUT Type: Portable Handset	Page 20 of 27	



6

EQUIPMENT LIST

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	N9038A	MXE EMI Receiver	N/A	N/A	N/A	MY51210133
Rohde & Schwarz	FSW67	Signal / Spectrum Analyzer	N/A	N/A	N/A	103200
Sunol	JB5	Bi-Log Antenna (30M - 5GHz)	N/A	N/A	N/A	A051107
Emco	3115	Horn Antenna (1-18GHz)	N/A	N/A	N/A	9704-5182
Amplifier Research	15S1G6	Amplifier	N/A	CBT	N/A	433975
SPEAG	EUmmWV4	EUmmWV4 Probe	1/11/2021	Annual	1/11/2022	9523
SPEAG	SM 003 100 AA	10 GHz System Verification Antenna	8/12/2021	Annual	8/12/2022	1004
SPEAG	DAE4	Dasy Data Acquisition Electronics	9/15/2021	Annual	9/15/2022	1449
SPEAG	EX3DV4	SAR Probe	6/29/2021	Annual	6/29/2022	7659
SPEAG	DAE4	Dasy Data Acquisition Electronics	6/21/2021	Annual	6/21/2022	1678
SPEAG	D6.5GHzV2	6.5GHz SAR Dipole	1/12/2021	Annual	1/12/2022	1019
Control Company	4352	Long Stem Thermometer	1/24/2020	Biennial	1/24/2022	200043634
Agilent	SMF100A	Signal Generator	5/7/2020	Biennial	5/7/2022	101590
Rohde & Schwarz	SMU200A	Vector Signal Generator	5/12/2020	Biennial	5/12/2022	104145
Agilent	8753ES	S-Parameter Vector Network Analyzer	2/2/2021	Annual	2/2/2022	US39170122
SPEAG	DAK-3.5	Dielectric Assessment Kit	5/12/2021	Annual	5/12/2022	1070

Note:




- Each equipment item was used solely within its respective calibration period.
- CBT (Calibrated Before Testing). Prior to testing, the measurement paths containing a cable, amplifier, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator) to determine the losses of the measurement path. The power meter offset was then adjusted to compensate for the measurement system losses. This level offset is stored within the power meter before measurements are made. This calibration verification procedure applies to the system verification and output power measurements. The calibrated reading is then taken directly from the power meter after compensation of the losses for all final power measurements.

FCC ID: A3LSMS908E	 PCTEST Proud to be part of  Samsung	WIFI 6 GHZ RF EXPOSURE EVALUATION	Approved by: Technical Manager
Document S/N: 1M2109220110-25.A3L	Test Dates: 11/08/2021 – 12/08/2021	DUT Type: Portable Handset	Page 21 of 27

7 MEASUREMENT UNCERTAINTIES




Applicable for SAR measurements:

a	b	c	d	e= f(d,k)	f	g	h= c x f/e	i= c x g/e	k	
Uncertainty Component	IEEE 1528 Sec.	Tol. (± %)	Prob. Dist.	Div.	c _i lgm	c _i 10 gms	lgm u _i (± %)	10gms u _i (± %)	v _i	
Measurement System										
Probe Calibration	E.2.1	9.3	N	1	1	1	9.3	9.3	∞	
Axial Isotropy	E.2.2	0.25	N	1	0.7	0.7	0.2	0.2	∞	
Hemishperical Isotropy	E.2.2	1.3	N	1	0.7	0.7	0.9	0.9	∞	
Boundary Effect	E.2.3	2	R	1.732	1	1	1.2	1.2	∞	
Linearity	E.2.4	0.3	N	1	1	1	0.3	0.3	∞	
System Detection Limits	E.2.4	0.25	R	1.732	1	1	0.1	0.1	∞	
Readout Electronics	E.2.6	0.3	N	1	1	1	0.3	0.3	∞	
Response Time	E.2.7	0.8	R	1.732	1	1	0.5	0.5	∞	
Integration Time	E.2.8	2.6	R	1.732	1	1	1.5	1.5	∞	
RF Ambient Conditions - Noise	E.6.1	3	R	1.732	1	1	1.7	1.7	∞	
RF Ambient Conditions - Reflections	E.6.1	3	R	1.732	1	1	1.7	1.7	∞	
Probe Positioner Mechanical Tolerance	E.6.2	0.4	R	1.732	1	1	0.2	0.2	∞	
Probe Positioning w/ respect to Phantom	E.6.3	6.7	R	1.732	1	1	3.9	3.9	∞	
Extrapolation, Interpolation & Integration algorithms for Max. SAR Evaluation	E.5	4	R	1.732	1	1	2.3	2.3	∞	
Test Sample Related										
Test Sample Positioning	E.4.2	2.70	N	1	1	1	2.7	2.7	35	
Device Holder Uncertainty	E.4.1	1.67	N	1	1	1	1.7	1.7	5	
Output Power Variation - SAR drift measurement	E.2.9	5	R	1.732	1	1	2.9	2.9	∞	
SAR Scaling	E.6.5	0	R	1.732	1	1	0.0	0.0	∞	
Phantom & Tissue Parameters										
Phantom Uncertainty (Shape & Thickness tolerances)	E.3.1	7.6	R	1.73	1.0	1.0	4.4	4.4	∞	
Liquid Conductivity - measurement uncertainty	E.3.3	4.2	N	1	0.78	0.71	3.3	3.0	76	
Liquid Permittivity - measurement uncertainty	E.3.3	4.1	N	1	0.23	0.26	0.9	1.1	75	
Liquid Conductivity - Temperature Uncertainty	E.3.4	3.4	R	1.732	0.78	0.71	1.5	1.4	∞	
Liquid Permittivity - Temperature Uncertainty	E.3.4	0.6	R	1.732	0.23	0.26	0.1	0.1	∞	
Liquid Conductivity - deviation from target values	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞	
Liquid Permittivity - deviation from target values	E.3.2	5.0	R	1.73	0.60	0.49	1.7	1.4	∞	
Combined Standard Uncertainty (k=1)							RSS	13.3	13.1	191
Expanded Uncertainty (95% CONFIDENCE LEVEL)							k=2	26.5	26.1	

FCC ID: A3LSMS908E	 PCTEST Proud to be part of  Samsung	WIFI 6 GHZ RF EXPOSURE EVALUATION	 Samsung	Approved by: Technical Manager
Document S/N: 1M2109220110-25.A3L	Test Dates: 11/08/2021 – 12/08/2021	DUT Type: Portable Handset		Page 22 of 27

Applicable for Power Density Measurements:



a	b	c	d	e	f = c x f/e	g
Uncertainty Component	Unc. (± dB)	Prob. Dist.	Div.	c _i	u _i (± dB)	v _i
Measurement System						
Calibration	0.49	N	1	1	0.49	∞
Probe Correction	0.00	R	1.73	1	0.00	∞
Frequency Response	0.20	R	1.73	1	0.12	∞
Sensor Cross Coupling	0.00	R	1.73	1	0.00	∞
Isotropy	0.50	R	1.73	1	0.29	∞
Linearity	0.20	R	1.73	1	0.12	∞
Probe Scattering	0.00	R	1.73	1	0.00	∞
Probe Positioning offset	0.30	R	1.73	1	0.17	∞
Probe Positioning Repeatability	0.04	R	1.73	1	0.02	∞
Sensor Mechanical Offset	0.00	R	1.73	1	0.00	∞
Probe Spatial Resolution	0.00	R	1.73	1	0.00	∞
Field Impedance Dependence	0.00	R	1.73	1	0.00	∞
Amplitude and Phase Drift	0.00	R	1.73	1	0.00	∞
Amplitude and Phase Noise	0.04	R	1.73	1	0.02	∞
Measurement Area Truncation	0.00	R	1.73	1	0.00	∞
Data Acquisition	0.03	N	1	1	0.03	∞
Sampling	0.00	R	1.73	1	0.00	∞
Field Reconstruction	2.00	R	1.73	1	1.15	∞
Forward Transformation	0.00	R	1.73	1	0.00	∞
Power Density Scaling	0.00	R	1.73	1	0.00	∞
Spatial Averaging	0.10	R	1.73	1	0.06	∞
System Detection Limit	0.04	R	1.73	1	0.02	∞
Test Sample Related						
Probe Coupling with DUT	0.00	R	1.73	1	0.00	∞
Modulation Response	0.40	R	1.73	1	0.23	∞
Integration Time	0.00	R	1.73	1	0.00	∞
Response Time	0.00	R	1.73	1	0.00	∞
Device Holder Influence	0.10	R	1.73	1	0.06	∞
DUT alignment	0.00	R	1.73	1	0.00	∞
RF Ambient Conditions	0.04	R	1.73	1	0.02	∞
Ambient Reflections	0.04	R	1.73	1	0.02	∞
Immunity/Secondary Reception	0.00	R	1.73	1	0.00	∞
Drift of DUT	0.21	R	1.73	1	0.12	∞
Combined Standard Uncertainty (k=1)		RSS			1.34	∞
Expanded Uncertainty (95% CONFIDENCE LEVEL)		k=2			2.68	

FCC ID: A3LSMS908E	 PCTEST Proud to be part of 	WIFI 6 GHZ RF EXPOSURE EVALUATION		Approved by: Technical Manager
Document S/N: 1M2109220110-25.A3L	Test Dates: 11/08/2021 – 12/08/2021	DUT Type: Portable Handset		Page 23 of 27

9.1 Measurement Conclusion

The SAR and power density measurements indicate that the DUT complies with the RF radiation exposure limits of the FCC, with respect to all parameters subject to this test. These measurements were taken to simulate the RF effects of RF exposure under worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests. The results and statements relate only to the item(s) tested.



Please note that the RF Exposure and distribution of electromagnetic energy in the body are very complex phenomena that depend on the mass, shape, and size of the body, the orientation of the body with respect to the field vectors, and the electrical properties of both the body and the environment. Other variables that may play a substantial role in possible biological effects are those that characterize the environment (e.g. ambient temperature, air velocity, relative humidity, and body insulation) and those that characterize the individual (e.g. age, gender, activity level, debilitation, or disease). Because various factors may interact with one another to vary the specific biological outcome of an exposure to electromagnetic fields, any protection guide should consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables.

FCC ID: A3LSMS908E		WIFI 6 GHZ RF EXPOSURE EVALUATION		Approved by: Technical Manager
Document S/N: 1M2109220110-25.A3L	Test Dates: 11/08/2021 – 12/08/2021	DUT Type: Portable Handset	Page 24 of 27	



10

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Document S/N: 1M2109220110-25.A3L	Test Dates: 11/08/2021 – 12/08/2021	DUT Type: Portable Handset		Page 25 of 27

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FCC ID: A3LSMS908E		WIFI 6 GHZ RF EXPOSURE EVALUATION		Approved by: Technical Manager
Document S/N: 1M2109220110-25.A3L	Test Dates: 11/08/2021 – 12/08/2021	DUT Type: Portable Handset	Page 26 of 27	

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FCC ID: A3LSMS908E		WIFI 6 GHZ RF EXPOSURE EVALUATION		Approved by: Technical Manager
Document S/N: 1M2109220110-25.A3L	Test Dates: 11/08/2021 – 12/08/2021	DUT Type: Portable Handset	Page 27 of 27	